WALNUT STREET BRIDGE
(County Bridge No. 14)
Formerly spanning Saucon Creek
Hellertown
Northampton County
Pennsylvania

HAER No. PA-206

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

Historic American Engineering Record
National Park Service
Department of the Interior
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HISTORIC AMERICAN ENGINEERING RECORD

WALNUT STREET BRIDGE
(County Bridge No. 14)

HAER No. PA-206

Location:	Formerly crossing Saucon Creek on Walnut Street, near Wagner's Mill, Hellertown, Northampton County, Pennsylvania. UTM: 18/470800/4491130 Quad: Hellertown, Pennsylvania
Date of Construction:	c. 1860. Original location and construction unknown.
Fabricator:	Charles Nathaniel Beckel Beckel Iron Foundry and Machine Shop, Sand Island, Bethlehem, Pennsylvania
Present Owner:	Hellertown Historical Society 150 West Walnut Street Hellertown, PA 18055
Present Use:	None
Significance:	Only high-truss span built by Beckel Iron Foundry known to exist. Uses Francis C. Lowthorp's 23 June 1857 patented cast lower chord connection. Deck beams on this and two other existing Beckel pony-truss cast- and wrought-iron bridges fabricated from cast- rather than wrought-iron.
Historian:	Robert W. Hadlow, August 1991

The Walnut Street Bridge, in Hellertown, Pennsylvania, is a composite cast- and wrought-iron Pratt-truss span. It is one of the oldest all-metal bridges in the United States and is one of three fabricated by Charles N. Beckel, of nearby Bethlehem, that exist today. Composite cast- and wrought-iron bridges form part of the progression in American bridge design, achieving wide popularity in the 1850s, 1860s, and early 1870s. Many saw them as more durable than all-wood or wood and iron spans. Nevertheless, enthusiasm for them waned with the advent of less costly methods of wrought iron and steel production after the Civil War. By the late 1870s composite cast- and wrought-iron bridge fabrication had nearly vanished.

History of the Site

Walnut Street Bridge once spanned Saucon Creek at the edge of the borough of Hellertown near Wagner's Grist Mill, a popular mill site since the 1760s. Originally, Simon Heller received the surrounding land as a grant from Thomas and Simon Penn in 1746 and 1761. In the next ten years the mill site passed through a handful of owners until Christopher Wagner purchased it in 1772, milling grain in addition to lumber. The land and buildings remained in the Wagner family, passing from one generation to another, until 1914 when George A. Keck purchased the mill site for $10,000. Keck sold the property in 1945 and the subsequent owner deeded it to the Borough of Hellertown in 1965. Since 1984 the Hellertown Historical Society has leased the property and buildings from the borough.[1]

There has been a bridge at the Walnut Street crossing of Saucon Creek since at least 1861. A list of county bridge repairs confirms this. In addition, since the early 1800s the Wagner family owned land and lived on either side of the creek near their mill. Its members likely travelled back and forth across the stream along Walnut Street. The route was and is a portion of one of a number of country lanes that criss-crossed Lower Saucon Township. It provided a pike for local farmers to travel to Wagner's and other grist mills and to Hellertown's shops.

Building of the Walnut Street Bridge

By the mid-nineteenth century, Pennsylvania counties such as Northampton built and maintained bridges, even if they were part of borough or township roadways. Fragmented official records of Northampton county reveal little about the Walnut Street Bridge. Lists of expenses of the county commissioners from 1855 to 1883 make no mention of new bridge construction over Saucon Creek on

Hellertown's Walnut Street. While there is an entry in 1855 for construction of a new bridge at Hellertown, at a cost of $899.47, it does not include details or exact location of the span. This bridge was not the structure on Walnut Street because it predates a mark on an inclined end post that notes a 23 June 1857 patent. This structure was probably a wood bridge on the Water Street crossing of Saucon Creek in Hellertown. Local historians confirm that a covered bridge existed there through the early 1930s, when it was deemed unsafe for modern loads and replaced.

Entries for bridges on Walnut Street begin appearing in the list of expenses for 1861. That year, Jos. Frankenfield received $3.75 to repair "Wagners Bridge." The span was so named because it stood near a grist mill operated by the Wagner family. Similarly, other local businessmen, in 1866, 1870, 1873, and 1876, received from $5.50 to $34.00 for repairs to "Wagners Mill Bridge." Most likely they repaired or replaced wood members of the span, repointed masonry abutments, or repainted the structure. In 1879, however, the county paid the firm of Tippet and Wood $248.33 for repairs to the bridge at Wagner's Mill, an amount much larger than earlier repair costs. It leads one to speculate that this company may have moved a bridge to the Walnut Street crossing from another site within Northampton County.[2]

Tippet and Wood, of Phillipsburg, New Jersey, was an iron-sheet and layered-steel manufacturer. The firm was most noted regionally for fabricating the Northampton Street suspension bridge across the Delaware River, between Easton, Pennsylvania and Phillipsburg, New Jersey. Tippit and Wood also constructed the dirigible mooring mast at Lakehurst, New Jersey, where, by chance, the German airship Hindenburg exploded as it prepared to dock in 1937. It is not known if Tippit and Wood erected the bridge on Walnut Street, as the firm's daybooks and other records important to this research are held privately and are unavailable for research.

The Beckel Iron Foundry and Machine Shop

Northampton County embarked on an ambitious bridge building campaign in the 1860s and 1870s. From 1861 to 1874 it let contracts for at least seventeen iron spans, ranging in cost from $1,400 to $5,400. One prominent fabricator during these years was Bethlehem's Charles Nathaniel Beckel.[3]

Beckel's father, Charles Frederick, was from a prominent Bethlehem Moravian family. In 1825 he purchased a small foundry located on the edge of the city's business district. A year before, Joseph Mikseh, a locksmith, had begun its construction but died before completing it. Charles F. Beckel was a watchmaker who purchased the foundry and machine shop from

Mikseh's estate in early 1825 and began working iron. By 1829 he moved his operation to an island between the Lehigh River and the newly completed Lehigh Canal to take advantage of water power to operate his blast.[4]

The Beckel Iron Foundry and Machine Shop, under the direction of Charles Frederick, was most noted for its cast cookware and farm implements. Not until Charles Nathaniel entered the business in the late antebellum years did the firm begin to produce ornamental fences and fence posts, hot air furnaces for homes and public halls, large clocks for church towers and municipal buildings, and cast- and wrought-iron bridges.

The Beckel Foundry erected twenty-one iron bridges throughout the state from 1861 to 1885, principally in Northampton, Lehigh, Lancaster, and Bucks counties. But C. N. Beckel did venture out of Pennsylvania on at least one occasion, to work with F. C. Lowthorp in 1864 on a drawbridge across Newark Bay in New Jersey. Charles N. Beckel suffered a stroke in August 1879, and lived as an invalid from then until his death in March 1888.[5]

Design of the Bridge

The Walnut Street Bridge is a counter-braced Pratt through-truss composed of five panels. While in service in Hellertown, the 25' high cast- and wrought-iron superstructure spanned nearly 55' between stone abutments. The main deck was 12' wide, with an additional 4'-6" for the sidewalk cantilevered from the northern truss (see Appendix for bridge dimensions).

A Pratt truss is a simply-supported spanning structure in which the chords resist the structure's tendency to bend by developing internal compression forces at the top and tension forces at the bottom. The web resists overall shear by developing internal compression forces in vertical panel posts and tension forces in diagonal braces. Iron bridges from the 1850s through the early 1870s typically used less expensive cast iron, a brittle material weak in tension, for compression elements, and wrought iron, a strong ductile material, for tension elements. Designers proportioned structural members to resist forces efficiently while minimizing material and, consequently, weight and costs.

Beckel made the upper chords and web posts of the Walnut Street Bridge from tapered, hollow iron castings with circular cross sections. This was an appropriate form because it was rigid enough to prevent long, unbraced compression members from buckling or bending out under compressive force. In addition, top chords, which resist the maximum bending forces at the truss mid-span, and the inclined end posts, which resist the maximum shear forces at the truss support, were tapered such that their

diameter was greatest at their centers, where buckling strength was most critical. Top chords also have a tendency to sag under their own weight. This bending, which was greatest at the mid-span of each casting, was resisted more efficiently by deeper cross sections.

Hip verticals on the Walnut Street Bridge are compression members, identical to the web posts. This variation on the usual Pratt truss arrangement in which hip verticals act in tension as suspenders supporting the lower chord, was a modification which resulted from the incorporation of counterbraces into the end panels.

Beckel cross-braced the central panel with wrought-iron rods. Braces in the adjacent panels, which resist the greater forces imposed by bridge self-weight and symmetrical deck loads, were wrought-iron rod pairs of larger diameter. Single rod counter-braces pass between each brace pair. Their purpose was to stabilize the truss when loaded on one side only, an essential function for all light-weight iron trusses carrying live loads that were large compared to the structure's own weight. To prevent the braces from becoming loose when the counter-braces were in action, it was customary to give the braces, counter-braces, and lower chords an initial tension. In the Walnut Street Bridge, brace rods could be tightened at the lower chord connection casting where threaded ends were secured by square or hexagonal nuts.

The lower chord assembly on the Walnut Street Bridge contains four continuous wrought-iron rods, each constructed from five segments, threaded at their ends and spliced together with long hexagonal nuts. This permitted the chord area to be increased in the central panel where chord tension forces were greatest. These central panel rod segments were "upset" or hammered during fabrication to taper the ends to an increased diameter. This compensated for the area reduction caused by cutting threads into the rod. Additional nuts placed at the center panel lower-chord castings and end post supports prevented these connections from sliding along the lower chord and may have been useful in stabilizing the truss during construction.

Beckel employed at least one and maybe two patented lower-chord castings perfected by Trenton, New Jersey, engineer Francis C. Lowthorp. In his letters of patent of 30 June 1857, No. 17,684, Lowthorp claimed to have invented a practical, economical type of "lower-chord plate" through which bridge fabricators could connect wrought-iron tension members, such as eye-bar diagonal counters and threaded lower-chord rods.

Lowthorp's second lower chord connection patent, No. 27,457, dated 13 March 1860, presented a modification to the 1857 patent. He replaced the brace-rod pin connection with anchorages for threaded rods. The chord rods were attached by "T-heads".

Beckel's lower-chord connection castings show the use of Lowthorp's 1857 lower-chord rods and plate design, but also show use of the 1860 patent design for connection of diagonal counters, that is, the use of threaded wrought-iron rods. Beckel cast the deck beam, the cantilevered walkway, and the lower chord connection plate between them as one integral piece. The lower chord casting, termed a "straining plate" by Lowthorp, was symmetrical, permitting cast-iron beams and lateral braces to be bolted to both sides. An existing photograph of a Beckel bridge over Bushkill Creek in Easton, Pennsylvania depicts a triple truss version of the cast- and wrought-iron span located on Walnut Street.

Lowthorp's lower-chord casting was essentially a rectangular block modified to provide a keyed seat for the panel web post, anchorage for panel and lateral bracing rods, a connection for cast-iron deck beams, and a stable connection to the continuous lower chord rods. Lowthorp succeeded, within an economical form, to connect all elements in the plane of the truss such that center lines intersected at one point, eliminating undesirable eccentricities.

The texts of patent claim letters in which Lowthorp described this invention addressed the requirements of fabrication, transport, erection, maintenance, and in-service performance. He also emphasized structural integrity coupled with material economy. The casting, he claimed, was designed to permit a less expensive lower-chord assembly that could be easily adjusted or replaced. Lowthorp accomplished this without imparting tensile forces to his straining plate, thereby allowing it to be constructed from less costly, easier to shape, cast iron. On the Walnut Street Bridge, the continuous chord design, adapted from Lowthorp's 30 June 1857 patent, transmits lower chord tension forces from panel to panel directly through the spliced chord rods without affecting internal forces in the cast-iron connection plate.

One of the most distinctive features of the Walnut Street Bridge is the presence of the original deck beams, made of cast iron. Because cast iron is a brittle material weak in tension, designers usually did not use it for structural beams which always resist bending forces by developing internal tensile as well as compressive stresses. Beckel's continuous I-beams, with tapered flanges and reinforced webs, were specifically created to

keep tension stresses in the cast iron to a minimum. By cantilevering beyond one truss to support the sidewalk, the beams actually bent less than they would have without it. The tapered I-section had flanges which curve in plan, widening at the center of the main span and distributing material in such a way that the flange tension stresses were minimized. Web-stiffener bars were cast integrally with the web plate to form a four-panel truss-like pattern of verticals and diagonals. These deck beams also functioned as compression struts which, when combined with the cross-bracing, were part of the lateral bracing assembly of the superstructure. Interestingly, this additional role, rather than further taxing the beam, may have relieved critical tensile stresses. If the lower lateral cross-bracing rods were given an initial tension, the resulting compression force in the deck beams would act as a kind of compressive prestressing counteracting the internal tension forces due to bending.

Lateral struts connecting the upper chords functioned similarly. As unloaded beams they simply supported their own weight, but as part of the lateral bracing assembly they carried axial compressive force. They were constructed of tapered cast-iron I-sections curved in plan and elevation with a serpentine open web pattern of seven panels.

Currently out of service, the Walnut Street Bridge was moved to a park site adjacent to its former location over Saucon Creek. Most of the lower chord and lateral bracing rods are bent or broken. Two web posts are cracked and several areas are critically corroded. Although two base plates survive, there is not enough evidence to determine the original configuration of the support. Photographs of the span as it appeared on the crossing in the late 1960s, along with photos of other Beckel bridges, have helped to provide a better understanding of the portions of the structure that are missing.

Repair and Maintenance

Maintenance records available from the Northampton County Office of Public Works reveal nothing about repairs made to the span. A brass plaque, once affixed to a masonry approach near the east end of the bridge when it was spanning Saucon Creek, reveals that it underwent repairs in 1950. It is unknown what this means. A photo from 1940 suggests that the masonry approach walls did not exist prior to 1950. Examination of the bridge today reveals no additions of steel I-beams to strengthen deck beams nor any other visible modifications to the structure. It is believed that the 1950 repair schedule included replacing the wooden deck; adding "U"-shaped angle steel rail along the vertical posts, three feet above the deck; pouring new masonry approach walls; and repainting the entire structure.[6]

In the late 1960s, Lower Saucon Township and the Borough of Hellertown combined their school districts and selected a site south of Hellertown on which to construct a new high school. A consequence of choosing this site was that many school buses would travel across the Walnut Street Bridge ferrying children from outlying parts of the township to the school. Prior to the opening of the school, the district petitioned the county commissioners to replace Walnut Street Bridge because its load limit restrictions prevented it from safely carrying fully-laden school buses. As a result, the commissioners approved construction of a deck-girder span to replace the cast- and wrought-iron bridge.[7]

Normally, when a contract was let for reconstruction of county bridges, the old spans became the contractor's salvage. But through friendly persuasion by a few Hellertown residents, the contractor made the span available to the borough. Soon local public works employees, with the aid of a large crane, picked up the iron bridge and moved it 25 yards off site to make way for the new span.[8]

In the past 20 years, Hellertown has done nothing to restore or renovate the Walnut Street Bridge for use somewhere else within its jurisdiction. Nevertheless, in 1991 the borough deeded the span to the Hellertown Historical Society with the hope that this volunteer organization might find a suitable use for the structure.

Project Information

This recording project is part of the Historic American Engineering Record (HAER), National Park Service. It is a long-range program to document historically significant engineering and industrial works in the United States.

The Cast- and Wrought-Iron Bridges Recording Project was co-sponsored in 1991 by the Historic American Engineering Record and the West Virginia University Institute for the History of Technology and Industrial Archaeology. Fieldwork, measured drawings, historical reports, and photographs were prepared under the general direction of Dr. Robert J. Kapsch, Chief, HABS/HAER; Eric N. DeLony, Chief and Principal Architect, HAER; Emory L. Kemp, Director, Institute for the History of Technology and Industrial Archaeology, and Dean Herrin, HAER Staff Historian.

The Recording Team consisted of Christine Ussler (Architecture Faculty, Lehigh University), Architect and Field Supervisor; Christine Theodoropoulos, P.E. (Architecture Faculty, California State Polytechnic University, Pomona); Wayne Chang (University of

Notre Dame), Monika Korsos (Technical University of Budapest, Hungary, US/ICOMOS), Architectural Technicians; Robert W. Hadlow (Washington State University), William Chamberlin, P.E., Historians; and Joseph E. B. Elliott (Muhlenberg College), Photographer.

APPENDIX 1. The Beckels of Bethlehem

Charles Frederick Beckel was a musician, watchmaker, silversmith, and businessman who lived his entire life in Bethlehem, Pennsylvania. He founded the town's first iron works, one that played a great role in providing cast-iron products to the people of the Bethlehem area of the state. His son, Charles Nathaniel, and his grandson, Lawrence Levering Beckel, continued his iron business for most of the nineteenth century.

On 16 May 1801, Charles F. Beckel was born in the Moravian community of Bethlehem, a member of the third generation of a pioneer family of the village. At a young age he was apprenticed to learn watchmaking. He wed Charlotte F. Braun in August 1823. The young couple moved to nearby Doylestown where Charles continued in the watchmaking craft.

The Beckels returned to Bethlehem sixteen months later. At that time he purchased an uncompleted foundry and machine shop from Joseph Mikseh. Located on Bethlehem's Main Street, where Beckel ran the blast for the foundry from horse power, the plant manufactured plows, stoves and other articles. Beckel, though, saw the need to enlarge his business and wished to harness the waterpower of the nearby, recently completed Lehigh Canal.

The Beckel Iron Foundry and Machine Shop was rebuilt on Sand Island, on the south end of old Bethlehem; there it existed until the 1890s. The Manufactories and Manufactures of Pennsylvania guide from 1875 suggests that the buildings on the island consisted of a two-story "main building measuring 30' by 50'." The first floor housed the general machine shop and the second the pattern shop. Adjacent to the shop was the foundry, from which Beckel produced both green and dry castings. He enlarged his business to include ore crushers, hoists, pumps, and the patented "Beckel's Improved Brick-set Heater" for homes and offices. (See sketch of Beckel Foundry, from January 1892.)

Charles F. Beckel and his wife, Charlotte, had four children, including Charles Nathaniel, born on 29 May 1827, in Bethlehem. The younger Charles attended the local parochial school and later apprenticed as a carpenter. Beckel soon worked for this father as a wood carver, creating patterns for iron castings. By 1860 he became interested in constructing cast- and wrought-iron bridges. He studied their "design, manufacture and erection" under "one of the most prominent engineers and bridge builders in the country." Beckel's mysterious mentor was probably Francis C. Lowthorp of Trenton, New Jersey, an engineer who had taken out patents on many components used in cast- and wrought-iron bridges. Lowthorp had at one time been master bridge builder for

the New Jersey Central Railroad and built many spans for rail lines such as the LeHigh Valley and other roads.[9]

The Beckel Foundry created at least twenty-one cast- and wrought-iron bridges. Receipts and Expenditures ledgers of the Commissioners of Northampton County are the most complete record of Beckel bridges. From 1861 to 1883, the foundry created fifteen spans for the county. The Beckels built at least one more structure in the county that is not included in the commissioners' records: two spans of the New Street Bridge in Bethlehem. The reason for its omission from the record was that it was built for a private toll company, and not the county; there would be no records of transactions pertaining to this project.

Beckel employed at least one and maybe two lower-chord castings patented by Trenton, New Jersey engineer Francis C. Lowthorp. To support a vertical post, he invented a practical, economical type of "lower-chord plate" made of cast iron and less costly to manufacture than if it were wrought.

The Beckel Foundry was most active in bridge fabrication between 1861 and 1874. Reasons for the decline in these pursuits is unknown. By the 1870s, Charles Nathaniel's son, Lawrence Levering Beckel, was helping his father with the foundry. Born on 25 August 1851, in Bethlehem, Lawrence attended the local Moravian Parochial School, and in 1874 enrolled at Lehigh University. There, he supposedly studied engineering, a subject for which the school was well known. While a family history suggested that Lawrence "took a special course of study [in engineering]" at Lehigh, directories of enrolled students show only that he attended the school for nor more that one year. He probably studied subjects required of all entering freshmen, such as classical languages, mathematics, and history. In any event, the lack of evidence that L. L. Beckel earned a degree in engineering from Lehigh, or that he studied there more than one year, suggest that he learned the art of bridge building by apprenticing with his father.[10]

The same family history also notes that L. L. Beckel "learned the machinists' trade at the Beckel Foundry." This was probably the extent of his post-secondary education. But it appears that he did help his father build bridges. An 1890s photograph of L. L. Beckel standing before a triple-high-truss eight-panel cast- and wrought-iron span over the Bushkill Creek, in Easton, attributes the bridge to him and his father. The date of construction for this structure is not known; interestingly, county records of receipts and expenditures do not list it. Presumably, this span

was another of the bridges that the Beckel Foundry fabricated for a private toll company.

Charles N. Beckel suffered a stroke on 18 August 1879. According to his obituary, from the Bethlehem Daily Times of 8 March 1888, he "was suddenly stricken with paralysis, which left him a helpless invalid for the [next] nine years, four years of which he passed almost entirely within doors." The once-energetic businessman, who also served as Bethlehem's Chief Burgess during the 1870s, died on 7 March 1888 at the age of 61 years.

The Beckel Foundry's bridge building activities subsided by the 1880s. One might suspect this with the increased popularity of all wrought-iron and all steel spans. By the early 1890s the foundry had closed. An economic recession that gripped the U.S. in those years, which ultimately became the Panic of 1893, caused "financial reverses" for the company. Charles N. Beckel had also lost money in an investment in a slate quarry and his brother, Louis, owed $10,000 to a local savings bank. In addition, the foundry had "priced [its product] out of the market," because Bethlehem Steel Company and other metal manufacturers could produce similar products at lower cost.

A trust company and a local entrepreneur, W. E. Doster, took over the foundry and property on Sand Island. Doster dismantled the foundry's buildings and turned the island into a park.

Lawrence L. Beckel went on to work as a night foreman for Bethlehem Steel Company. He also operated a bicycle and automobile repair shop on Bethlehem's Main Street. Beckel died on 3 March 1909.

APPENDIX 2. Francis C. Lowthorp[11]

Francis C. Lowthorp was born on 8 February 1810 in New York City to Thomas and Mary Ann (Lilly) Lowthorp. Born in London, England, in 1782, Thomas emigrated to the United States in 1798 and soon settled in Albany, New York, where he met his future wife, the daughter of the Rev. Samuel Lilly. Moving to New York City, he worked for Elias Kane, one of the city's leading importers. In 1810 the Lowthorps moved to Geneva, New York, where Thomas entered the wholesale and retail general merchandise trade. He formed the firm Thomas Lowthorp & Company, with Kane and William Lilly as associates.

In 1813, Lowthorp was part of a consortium that applied for a charter for the Seneca Lock and Navigation Company to open a water route between Seneca and Cayuga Lakes. He was so well respected by his friends that the Order of Cincinnati bestowed upon him an honorary membership.

The third child in his family, Francis was in constant poor health as a youngster and his parents sent him to live with an uncle, Dr. John Lilly of Lambertville, New Jersey. There, he presumably recovered from his sickliness.

Lowthorp began his long career in the field of engineering as a young man working for Ashbel Welch on construction of the Delaware and Raritan Canal. He later became the principal assistant engineer on the building of the Upper Grand section of the Lehigh Coal and Navigation Company's canal. This extended though the Lehigh Valley from White Haven to Mauch Chunk, Pennsylvania. Lowthorp had direct supervision over construction of several locks on the system, including a 65' single-lift lock above Penn Haven.

In 1838, after completion of the Upper Grand section of the canal, Lowthorp and three partners erected an iron furnace at Mauch Chunk. There, they smelted anthracite iron. In this process, iron ore is refined with the hot blast that anthracite coal creates. Aware of English success with this method, the partners knew that no one in the U. S. had as yet perfected it. They became the first in this country to market the high quality product.

Lowthorp soon designed and oversaw the construction of bridges for the Beaver Meadow Railroad. Eventually, he received the "first award" for plans for an iron bridge carrying Chestnut Street across the Schuylkill River in Philadelphia. He then designed and built the Pennsylvania Railroad bridge over the Susquehanna in Harrisburg.

From 1851 to 1854, Lowthorp was the bridge construction engineer for the LVRR. He designed the first railway bridge across the Delaware River at Easton, Pennsylvania. A two-tiered span, it connected the L.V.R.R. with the New York Central and Belvedere & Delaware railroads.

During 1856 and 1857, he worked for the firm of Cartwright and Company designing and superintending erection of the Jordan Creek bridge near Allentown, Pennsylvania, for the Catasauqua & Foglesville Railroad. This 1,120-foot span was 89' above the river and built solely of iron. Many engineers criticized Lowthorp's simple design and placed bets on when it would collapse under load. The bridge, though, outlasted its detractors and carried machinery far heavier than anyone had envisioned.

Lowthorp became a consulting engineer and designed many more spans. He was best known for those associated with the Newark & New York and the New York & Long Branch railroads. For the latter road his most notable contribution was a swing span across the Raritan Bay. In 1864 he built the original Newark Bay drawbridge for the Central Railroad of New Jersey. Only in 1926 was it replaced by a vertical-lift span designed by J. A. L. Waddell.

Lowthorp held many letters of patent related to the design of iron bridges. They included the following:

26 May	1857	#17,383	"Improved Hydro-dynamic Machine for Testing Strength of Materials"
30 June	1857	#17,684	"Iron Truss-Frame for Bridges"
3 Nov	1857	#18,548	"Iron Truss-Frame for Bridges"
13 Mar	1860	#27,457	"Plate for Securing Chords, Braces, &c of Truss-Bridge, &c"
19 Feb	1867	#62,278	"Improvement in Truss-Frame Bridges"

Today, less than a handful of 1860s and 1870s cast- and wrought-iron bridges in eastern Pennsylvania and western New Jersey include elements for which Lowthorp held patents.

He was elected a member of the America Society of Civil Engineers in 1868 and became a fellow of that organization in 1870. He retired from the profession in 1876.

Lowthorp married Anna B. Chambers at Beaver Meadow, Pennsylvania in 1841. She was the daughter of a Clark Chambers. The Lowthorps had two children, Francis C., Jr., and Mary. Lowthorp married a second time, to Anna M. Bailey in 1868. His son Francis became a prominent Trenton attorney.

Francis C. Lowthorp lived his retirement years in peace and died of natural causes on 1 June 1890 at home at 152 Greenwood Avenue in Trenton. According to his will and estate inventory he left his second wife and children nearly $30,000 in assets, a large sum in the late nineteenth century.

APPENDIX 3.

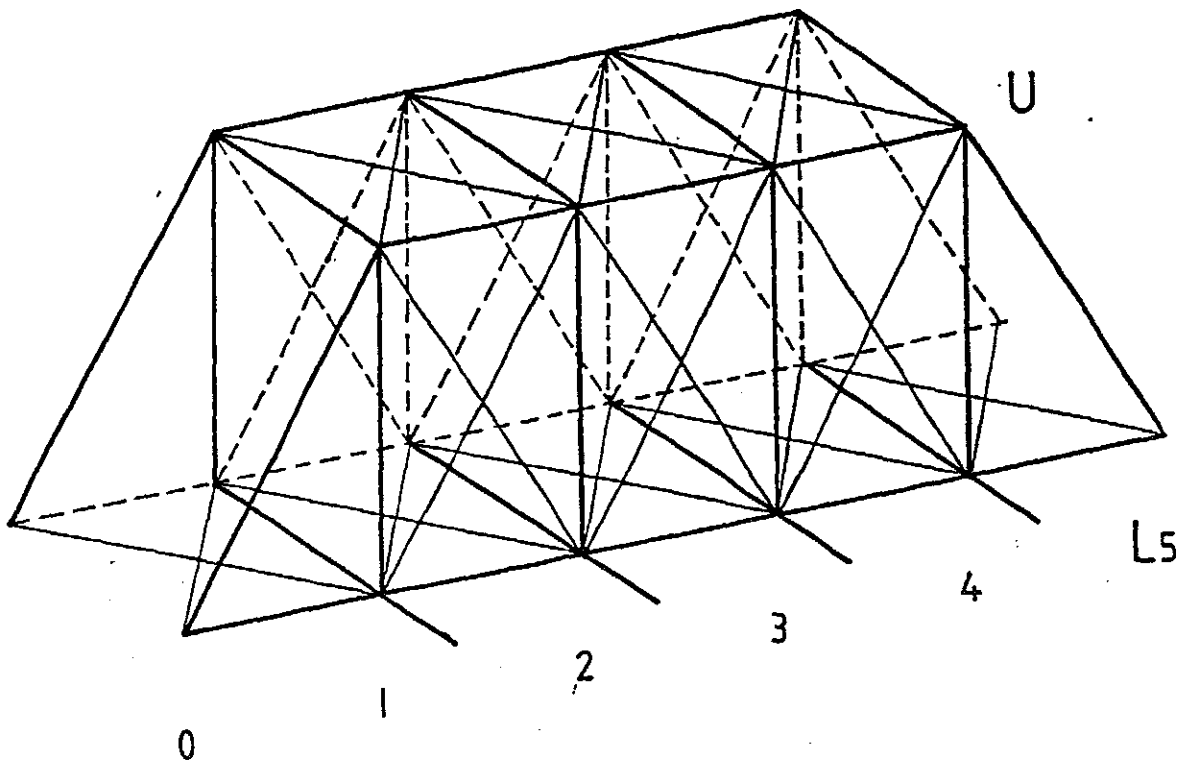

Table A: Bridge Dimensions

Truss type	Pratt through-truss
Number of spans	1
Number of panels	5
Panel width, center to center of web posts	from 11'- 0 5/8" to 11'- 3 1/2"
Bridge length, L_0 to L_5	55'- 6 1/2"
Distance between upper and lower chords, center to center	14'- 6 1/4"
Truss spacing, center to center	12'- 2 1/2"
Sidewalk cantilever span, center of truss to center of rail	4'- 6"

Data Limitations

Various sources were consulted in preparing this report. They include local, county and state government records, historical society archives, and library holdings.

The Borough of Hellertown records were limited to Council Minutes, which began in 1872. County Records located in the County Archives in Easton are, for the most part, not indexed and are extremely difficult to use. County Commissioners' Minutes for the second half of the nineteenth century are missing. The only portion of the collections labeled "roads and bridges" was a partial run of contracts dating from the 1890s through the 1940s.

In Pennsylvania, bridges on borough, township, or county roads are under the jurisdiction of the County Office of the Director of Public Works. A maintenance file for this bridge was found in Easton but was not current since the bridge was no longer county property. In addition, it covered only a short period, the two years before the span was removed from the site near Hellertown. At one time, the county engineer's office, under the jurisdiction of the Director of Public Works, had a large "portfolio" collection of maintenance records for all older county-owned bridges. This was last seen by HAER officials in the mid-1980s. Since then it has vanished.

The Hellertown Historical Society and the Northampton County Historical Society in Easton had no records to help researchers learn more about the Walnut Street Bridge. The Bethlehem Public Library has a large collection of local histories, newspaper scrapbooks, and vertical files that might aid the researcher. The Lehigh University Libraries' Archives and Special Collection's Division has many nineteenth century monographs on bridges and bridge building. There are few, if any references to Francis C. Lowthorp or Charles N. Beckel.

For the only sources on the Beckels of Bethlehem, Pennsylvania, see: Ralph Levering Beckel, "Genealogical and Biographical Record of the Pioneer George Frederick Boeckel (Beckel) and His Descendants," TMs, 1942, and Frederick Truman Beckel, "The Boeckel (Beckel) Family of Bethlehem, Pa," Tms, 1968, both found in the Bethlehem Room, Bethlehem Public Library, Bethlehem, PA. The organization, Historic Bethlehem, Inc., of Bethlehem, PA, has the most complete set of records from the Beckel Foundry. But these only include a fragmented collection of daybooks and ledgers. They shed little, if any, light on the period when C. N. Beckel and his son, L. L. Beckel fabricated bridges.

ENDNOTES

1. "History of the Grist Mill" TMs, Hellertown Historical Society, Hellertown, Pennsylvania, (chronology of land title and land use), 1-2.

2. Northampton County, Pennsylvania, "New Bridges" and "Bridge Repairs," 1855-1883, Record of Receipts and Expenditures, County Archives, Easton.

3. Northampton County, Pennsylvania, "New Bridges" and "Bridge Repairs," 1855-1883.

4. History of Northampton, Pennsylvania with Illustrations Descriptive of its Scenery, (Philadelphia and Reading: Peter Fritts, 1877), 204; Joseph Mortimer Levering, A History of Bethlehem: 1741-1892, (Bethlehem, PA: Times Publishing Co., 1903), 669.

5. "Obituary--Charles Nathaniel Beckel," Daily Times, (Bethlehem), 8 March 1888, 1.

6. A comparison of a black and white elevation photograph, from 1940, with color photos of east approach, and 3/4 shots of north and south elevations, from the late 1960s, reveal subtle changes evidenced from the 1950 repairs. All photos held by Hellertown Historical Society, Walnut Street, Hellertown, PA.

7. Saucon Valley School District to Northampton County Commissioners, 4 March 1969, Bridge No. 14, Bridge Files, Department of Public Works, Northampton County, Government Center, Easton, Pennsylvania.

8. Richard A. Heil, Chief Clerk, Northampton County Commissioners, to Paul Adams, Springtown, Pa, 14 June 1971, Bridge 14, Bridge Files; Photos held by Hellertown Public Works Department show operation of moving iron bridge off crossing in 1970 or 1971.

9. Ralph Levering Beckel, compiler, "Genealogical and Biographical Record of the Pioneer George Frederick Boeckel (Beckel) and His Descendants and including Genealogical and Biographical Records of Some Families Interrelated by Marriage,

1942" TMs [photocopy], pp. 36, 39, Bethlehem Room, Bethlehem Public Library, Bethlehem, Pennsylvania; Manufactories and Manufactures of Pennsylvania of the Nineteenth Century, (Philadelphia: Galaxy Publishing, 1875), 490; "Obituary--Charles Nathaniel Beckel," Daily Times (Bethlehem), 8 March 1888, 1.

10. See Lehigh University Catalogues for the 1870s, because they list the names and status of all enrolled students. They are located in the Archives and Special Collections, Linderman Library, Lehigh University, Bethlehem, PA.

11. For sources on the life and activities of Francis C. Lowthorp consult the following: R. Fleming, "Sixty-Year-Old Iron Bridge in a New Jersey Village: Oldest of Several Lowthorp Truss Highway Crossings of the Raritan . . .", Engineering News-Record 11 November 1920, 925-927; "Memoirs of Deceased Members--Francis C. Lowthorp, F.Am.Soc.C.E.," Proceedings of the American Society of Civil Engineers, 32(1894)196-98; Death notices and court documents are found in: "Death of Francis C. Lowthorp," Daily State Gazette (Trenton, New Jersey), 2 June 1890; "Death of Francis C. Lowthorp," Trenton Times, 2 June 1890; "Last Will and Testament of Francis C. Lowthorp," Proved 23 July 1890, Book L of Wills, Folio 200, Surrogate's Office, Mercer County, New Jersey, also held by New Jersey State Archives, Trenton, in docket 4665-K; "Inventory of the Estate of Francis C. Lowthorp," Proved 10 November 1891, Book L of Wills, Folio 496, Surrogate's Office, Mercer County, New Jersey, also held by New Jersey State Archives, Trenton, in docket 4665-K; Family lineage is found in: Edwin Robert Walker, et al., A History of Trenton, 1679-1929 (Princeton: Princeton University Press, 1929), 576, 621."Unconnected Immigrants," in E. B. Huntington, A Genealogical Memoir of the Lo-Lathrop Family in this Country, Embracing the Descendants, as far as known, of The Rev. John Lothropp, of Scituate and Barnstable, Mass., and Mark Lothrop, of Salem and Bridgewater, Mass., and the First Generation of Descendants of other names (Ridgefield, CT: Mrs. Julia M. Huntington, 1884; reprint edition, Portland, OR: E. H. Lathrop, 1971), 409-10 (pages from reprint edition).

SELECTED BIBLIOGRAPHY

Unpublished

Beckel, Frederick Truman. "The Boeckel (Beckel) Family of Bethlehem, Pa, 1968" TMs [photocopy]. Bethlehem Room, Bethlehem Public Library, Bethlehem, PA.

Beckel, Ralph Levering. "Genealogical and Biographical Record of the Pioneer George Frederick Boeckel (Beckel) and His Descendants and including Genealogical and Biographical Records of Some Families Interrelated by Marriage, 1942," TMs [photocopy]. Bethlehem Room, Bethlehem Public Library, Bethlehem, Pennsylvania.

"History of the Grist Mill, TMs [photocopy]. Hellertown Historical Society, Hellertown, Pennsylvania.

New Jersey. State Archives. Wills and Estates, Microform Records.

Pennsylvania. Northampton County. Commissioners' Records. County Archives.

_____. _____. Director of Public Works. Bridge Files, Bridge No. 14.

_____. _____. _____. County Engineer's Records--Gracedale Complex. Bridge Maintenance Card.

Published

"Death of Francis C. Lowthorp." Daily State Gazette (Trenton, NJ), 2 June 1890.

Fleming, R. "Sixty-Year-Old Iron Bridge in New Jersey City." Engineering News-Record, 11 November 1920.

"Historical Facts on Lehigh River Floods Recalled in Lecture: H. G. Payrow Reviews Extent of Damage Done, Together with Technical Data." Globe-Times, Bethlehem, PA), [May 1931]. Clipping Books. Bethlehem Room, Bethlehem Public Library, Bethlehem, Pennsylvania.

History of Northampton County, Pennsylvania with Illustrations Descriptive of its Scenery. Philadelphia and Reading: Peter Fritts, 1877.

Huntington, E. B. A Genealogical Memoir of the Lo-Lathrop Family in the Country. Ridgefield, CT: Mrs. Julia M. Huntington; reprint edition, Portland, OR: E. H. Lathrop, 1971.

Lehigh University Catalogue, 1872-1878. Archives, Lehigh University Libraries, Bethlehem, Pennsylvania.

Levering, Joseph Mortimer. A History of Bethlehem: 1741-1892. Bethlehem, PA: Times Publishing Co., 1903.

Loewenstein, Laurie. "Experts Hope to Save Birdge in L. Saucon." Globe-Times (Bethlehem, PA), 21 July 1985, B1, B2.

Manufactories and Manufactures of Pennsylvania of the Nineteenth Century. Philadelphia: Galaxy Publishing, 1875.

Miller, Tad. "Mill Listed as National Historic Site." Morning Call (Allentown, PA), 2 June 1987.

_____. "Neighbor Says Funds Available to Save Historic Span." Morning Call (Allentown, PA), 19 January 1987, B4B.

_____. "Residents, Fire Chief Oppose Relacing L. Saucon Span." Morning Call (Allentown, PA), 20 August 1987, B4.

"Obituary--Charles Nathaniel Beckel." Daily-Times (Bethlehem, PA), 8 March 1888, 1.

Walker, Edwin Robert, et al. A History of Trenton, 1679-1929. Princeton, NJ: Princeton University Press, 1929.